## REMARKS

By this amendment, Applicants have amended claim 9, and added new claims 30 and 31. As a result, claims 1-14, and 24-31 are pending in this application. These amendments are being made to facilitate early allowance of the presently claimed subject matter. Applicants do not acquiesce in the correctness of the objections and rejections and reserve the right to pursue the full scope of the subject matter of the original claims in a subsequent patent application that claims priority to the instant application. Reconsideration in view of the following remarks is respectfully requested.

In the Office Action, claim 9 is objected to for including a typographical error. In response, Applicants have amended claim 9 to correct this error. As a result, Applicants respectfully request withdrawal of this objection.

Further, the Office rejects claims 1-9 and 24 under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,486,502 (Sheppard et al.) in view of U.S. Patent No. 6,246,076 (Lipkin et al.). In particular, with respect to claim 1, the Office acknowledges that Sheppard et al. fails to disclose a nitride based device having a dielectric layer that includes silicon dioxide. However, the Office alleges that Lipkin et al. discloses this feature of the claimed invention.

Initially, Applicants respectfully submit that the Office misinterprets the teachings of Lipkin et al. In particular, Applicants note that Lipkin et al.'s device is a "semiconductor device for which the active portions are formed of silicon carbide." Col. 3, lines 5-6. In sharp contrast, Applicant's claimed invention comprises a nitride based device. By definition, the active portion of a nitride based device comprises nitrogen, which is absent from the silicon carbide active

portion of Lipkin et al. To this extent, Applicants note that, to date, silicon carbide devices and nitride based devices differ substantially. For example, the claimed nitride based device comprises a heterostructure, whereas heterostructure silicon carbide devices are not currently manufactured. Further, the two types of devices have dramatically different densities of surface states. Typically, a nitride based device has an electron sheet density that is ten to twenty times that of a silicon carbide device. Because of this difference, designs that do not work for silicon carbide devices may work for nitride based devices, and vice versa. As a result, Lipkin et al. does not disclose, *inter alia*, use of a silicon dioxide dielectric layer in a nitride based heterostructure device.

In support of the rejection, the Office alleges that Lipkin et al. shows that "silicon dioxide has low dielectric constant which makes it is more attractive for charge leaking prevention or current blocking in heterostructures." Applicants respectfully submit that the Office misinterprets the teachings of Lipkin et al. using the hindsight of Applicants' claimed invention.

In particular, interpreting Lipkin et al. only for the purposes of this response, Lipkin et al. does not suggest, *inter alia*, that a silicon dioxide dielectric layer could be used in the claimed nitride based heterostructure device. As is readily apparent, silicon carbide (SiC) and silicon dioxide ($SiO_2$) both include the same element, Silicon. As a result, $SiO_2$ is a "native" dielectric for silicon carbide-based devices as expressly discussed in Lipkin et al. For example, Lipkin et al. discusses how "silicon dioxide ($SiO_2$) provides an excellent insulator with a wide band gap and *a favorable interface between the oxide and the silicon carbide semiconductor material.* Thus, silicon dioxide is favored as the insulating material *in a silicon carbide IGFET.*" Col. 1, lines 60-64 (emphasis added). Further, Lipkin et al. goes on to state that "silicon dioxide *forms a*

*better interface*, in terms of electrically charged or active states, *with silicon carbide* than does any other dielectric material." Col. 6, lines 55-58 (emphasis added). This is further evidenced by the fact that Lipkin et al. exclusively describes the gate insulator structure as including "a layer of silicon dioxide... *on the silicon carbide layer*." Col. 3, lines 65-66 (emphasis added); FIGS. 1-4, 8 and corresponding discussions. As a result, Lipkin et al. fails to disclose anything more than the use of silicon dioxide as a dielectric material for a silicon carbide-based device.

Additionally, the Office fails to consider other important considerations in selecting an appropriate dielectric layer for a heterostructure device. For example, the discussion of Lipkin et al. cited above includes a discussion of the interface between the dielectric layer and semiconductor. To this extent, when the density of interface states between the dielectric layer and the semiconductor is high, the device will perform poorly. In particular, such a high density will lead to trapping, and dramatically reduce field effect mobility, diminish reliability, reduce the lifetime, etc., of the device. In fact, several unsuccessful attempts were made to use silicon dioxide as a gate dielectric for other materials such as gallium arsenide. These attempts failed due to a large density of interface states. Due to these failures, many in the semiconductor community anticipated similar results for nitride based materials as well. Lipkin et al. fails to provide any teaching, express or implied, that would lead one skilled in the art to assume otherwise.

In sharp contrast, Applicants' claimed invention comprises a nitride based heterostructure device having a silicon dioxide dielectric layer. Such a device is not taught or suggested by Lipkin et al. As a result, Lipkin et al., when properly construed, only teaches the use of silicon dioxide as a dielectric layer in a silicon carbide-based device, and fails to teach or suggest that a

layer comprising $SiO_2$ could be successfully used as a dielectric layer for a nitride based heterostructure device, without the hindsight of Applicants' claimed invention.

Further, Sheppard et al. does not cure this defect. In particular, using a dielectric for passivation is completely different from using the dielectric as a gate dielectric. For example, the concentration of carriers under a passivation film does not change much during device (e.g., the transistor in Sheppard et al.) operation. Consequently, any traps or localized states are either mostly filled or mostly empty and do not change their charge states during transistor switching or due to microwave bias. As a result, unlike the gate dielectric which is disposed between the gate and an active area of the device, the passivation film can include a large density of traps or surface states without having a detrimental effect on the performance of a device.

In light of the above arguments, Applicants respectfully submit that the invention of claim 1 is not obvious in light of Sheppard et al. and Lipkin et al. In particular, neither Sheppard et al. nor Lipkin et al., when properly interpreted, suggests, *inter alia*, applying a gate dielectric layer that includes silicon dioxide when producing nitride based heterostructure devices. As a result, Applicants respectfully request withdrawal of this rejection.

Still further, the Office rejects claims 10-14 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Sheppard et al. in view of Lipkin et al. With respect to claim 10, Applicants note that the Office relies on a similar interpretation of Lipkin et al. to maintain this rejection. As a result, Applicants herein incorporate the arguments presented above with respect to the rejection of claim 1. In light of these arguments, Applicants respectfully request withdrawal of the rejection of claim 10.

Additionally, the Office rejects claims 25-29 under 35 U.S.C. § 103(a) as allegedly being unpatentable over "DC, Microwave, and High-Temperature Characteristics of GaN FET Structures" (Binari et al.) in view of Lipkin et al. With respect to claim 25, Applicants note that the Office relies on a similar interpretation of Lipkin et al. to maintain this rejection. As a result, Applicants herein incorporate the arguments presented above with respect to the rejection of claim 1. In light of these arguments, Applicants respectfully request withdrawal of the rejection of claim 25.

Applicants respectfully submit that the various dependent claims, though not expressly addressed herein, are patentable for the above-stated reasons as well as for their own unique features. As a result, Applicants respectfully request withdrawal of the rejections of the dependent claims 2-9, 11-24, and 26-29. Further, Applicants respectfully submit that newly added claims 30 and 31 are allowable as presented.

In light of the above, Applicants respectfully submit that all claims are in condition for allowance. Should the Examiner require anything further to place the application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the number listed below.

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